manually (by dwell times and dwell positions insertion) to the second CTs. DVH parameters of OARs for two image series were compared and analyzed. It was tried to have a minimum time interval between the finishing of the treatment and second CT scanning. Paired samples T-test (Confidence Interval = 95%) was done for comparing the DVH parameters of two planning.

**Results:** Mean(%)±SD of the absolute DVH parameters differences for bladder, rectum and sigmoid, as the OARs of cervical cancer patients are reported in the following table.

| | D2cc (Mean(%)±SD) | D0.1cc (Mean(%)±SD) | D1cc (Mean(%)±SD) | D10 (Mean(%)±SD) | D30 (Mean(%)±SD) | D50 (Mean(%)±SD) |
|---|---|---|---|---|---|---|
| Bladder | 11.4±14.7 | 16.9±20.5 | 12.4±16.2 | 9.3±10.7 | 9.6±9.8 | 9.8±10.6 |
| Rectum | 13.7±11.1 | 18.3±11.0 | | 9.9±10.7 | 8.4±10.4 | 9.9±10.9 |
| Sigmoid | 12.5±11.9 | 13.8±12.3 | | 9.5±10.7 | 10.0±10.0 | 12.2±12.7 |

$$Mean = \frac{\sum_1^{30}\left|\left(\frac{DVHpB-DVHpA}{DVHpB}\right)\times 100\right|}{30}$$; DVHpB: DVH parameters of Before treatment CT, DVHpA: DVH parameters of After treatment CT

Some example of the Paired samples T-test results in term of Mean±SD(P-value) are: -0.24±1.63 (0.428), 0.063±0.72(0.635) and -0.11±0.74(0.425) for D2cc of bladder, rectum and sigmoid, respectively.

Although, results of the statistical analysis showed no meaningful variations between DVH parameters of before and after treatment CTs, but the absolute differences are not negligible, as it can be seen from the table.

**Conclusions:** Despite the fact that statistical results were not significant, but, the differences were large and even sometimes re-planning may be needed, if pre-treatment CT images were available just before the source loading to the applicators.

It can be concluded from the results that, the same as EBRT, also in the brachytherapy, on line imaging, just before, or even during, the source loading, provides a useful insight about the precision of the treatment. Conventional CT scan is not a best choice for online imaging, because of its high exposure, but the other modalities like ultrasound or C-arm can be used an alternative, if be available in the brachytherapy departments.

## Poster: Brachytherapy track: Head and neck

### PO-1030

### COBRA ontology: a proposal for a standardized data collection (SDC) for H&N patients treated with brachytherapy

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**Purpose/Objective:** Collecting data is expensive in terms of time and human resource. However data are collected differently and it is difficult to perform multi-center research based on previously stored data. The general objective of COBRA (COnsortium for BRachytherapy data Analysis) ontology is to define a specific data-set for SDC for H&N patients (pts) treated with brachytherapy (BT).

**Materials and Methods:** ENT-COBRA is a consortium for SDC for H&N pts treated with BT. It is linked with H&N GEC-ESTRO Working Group (WG) and composed by 11 centers (10 European and 1 Asian) from 6 countries. The ontology was defined by a multicenter WG, then, the proposal was evaluated by the consortium and by a multi-professional technical commission (TeCo) composed by a mathematician, an engineer, a doctor with experience in data storage, a programmer and a software (SW) expert.

**Results:** 227 variables were defined. Each variable has 4 properties: Name, Form, Type of Field and Levels. 13 Forms were proposed: 1) registry and history, 2) histology, 3) Staging, 4) Protocol, 5) Surgery, 6) Radiotherapy, 7) Neoadjuvant Chemotherapy (CT), 8) Concomitant CT, 9) Adjuvant CT, 10) BT, 11) Follow-up (repeated), 12) Outcome (automatically calculated based on F-up), 13) Images and Treatment files. Field types are: text, number, date, table, files. The chosen standard file formats are 'DICOM' for image and 'TXT files' for data treatment. All tables linked with variables are defined. The toxicity is stored with CTC4 scale and the RTOG scale (for back comparison with retrospective studies). RTOG scale was a forced choice because many data are stored using this and a direct mapping with CTC4 is not possible. There are 3 levels, each allowing for a specific type of analysis: 1) Registry level (epidemiology analysis), 2) Procedures level (standard oncology analysis), Research level (radiomics analysis). The variables of 'Registry level' are: pts code, Date of Birth, Gender, Ethnicity, Age, Site cancer, Multidisciplinary management, Institution, Histology type, therapy sequence, Death, Death Date, Cause of death. The third level includes image files. All other variables are in the 'Procedures' level. The ontology was approved by the consortium and by the TeCo. The ontology has allowed to implement an automatic function (brokers) in COBRA SW, so it is not time-consuming because can take the data from common storage systems already in use in various centers. Possible update of the ontology repository are planned on regular bases among Consortium partners.

**Conclusions:** The Ontology is a good answer to a multi-dimensional problem that involves data collection, retrieval, and usability. This allows to create SW for large multi-centers database with the implementation of specific functions such as 'brokers'. The latter seem to be well received by all involved parties, primarily because it does not change the center storing technologies, procedures and habits.

### PO-1031

### ENT COBRA (COnsortium for BRachytherapy data Analysis) : Standardized data collection (SDC) for H&N patients

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**Purpose/Objective:** Aim of the COBRA project is to create a consortium for SDC. The long term aim is building a Decision Support System (DSS) to allow treatment individualisation and perspective validation of these prediction models.
**Materials and Methods:** H&N GEC-ESTRO Working Group (H&N G-E WG) participated in the project defining the consortium agreement, the ontology (data-set) and peer-reviewing the general 'umbrella' protocol. The repository was realized on a SQL platform with an authorized web-based access of the centres.
**Results:** The project was approved by the H&N G-E WG in December 2012. Eleven centers (10 European and 1 Asian) from 6 countries signed the agreement. Then the consortium approved the ontology. We identified 3 levels for the data set: Registry (epidemiology analysis), Procedures (prediction models and DSS) and Research (radiomics). The consortium decided to divide data sharing in 2 phases: only data belonging to the 1st level will be stored in the 1st phase, while in the 2nd phase the data from the other levels. The COBRA-Storage System (C-SS) architecture was defined on the ontology basis as well on the Ethic Committee (EC) protocols. After some comments by an Italian EC, the C-SS was updated in order to improve privacy standards. The C-SS is not time-consuming, in fact due to the use of 'brokers' it can take the data directly from the centres storage systems by connecting with SQL, Access, File Maker Pro or Excel. The system is also structured to perform automatic archiving directly from the TPS or After loading machine. We are currently in discussion with several companies to offer this connection. The architecture is based on the concept of 'on-purpose data projection'. It means, that a temporary, 'virtual' repository is created 'ad hoc' each time and a new iteration is needed for research purposes. The C-SS architecture is privacy protecting, because it will never project data that could identify the individual patient. At the same time, whenever a new iteration of a model is needed, a fresh projection is newly produced on which the next iteration is calculated. This C-SS can also benefit from the so called 'distributed learning' approaches, in which data never leave the collecting institution, while learning algorithms and proposed predictive models travel instead, if some consortium members choose not to distribute their data.
**Conclusions:** Setting up a consortium appears to be a useful tool toward the creation of a multi-system data sharing architecture. The C-SS seems to be well accepted by all involved parties, primarily because it does not change the center storing technologies, procedures and habits. The upload of the data is planned to start in 2015 and we expect to begin creating predictive models as soon as the data collection phase is finalized

**Poster: Brachytherapy track: Physics**

**PO-1032**

**Choice of radionuclides for HDR Brachytherapy: clinical and economic differences**

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**Purpose/Objective:** There is a choice of Co-60 or Ir-192 for HDR Brachytherapy and recent research has suggested other alternative radionuclides, Co-57 and Gd-153, could be used. This study demonstrates the differences between these 4 radionuclides: physically, dosimetrically and economically.
**Materials and Methods:** A literature review looking at all 4 radionuclides was performed: physical size, specific activity, half- life, energy and shielding requirements were compared. Clinically patient follow up and local planning studies involving 20 patients for gynaecological HDR patients were examined for Co-60 and Ir-192, including typical treatment duration, prescription point and OAR patient dosimetry. The monetary cost of choosing Co-60 over Ir-192 was analysed over a 10 year HDR equipment life.
**Results:** Gd-153 while having a sufficient half-life (242 days) for HDR has insufficient mean photon energy at 60.9keV and would be more suitable for PDR or intermediate LDR. Co-57 has a half-life of 272 days, approximately 3.5 times longer than Ir-192 and has lower energy gamma emissions 123keV without electron contamination hence it requires less source shielding than Ir-192 and Co-60. Its radial dose function is greater and more uniform than that of Ir-192 but very similar to Co-60 therefore producing a more uniform dose. Ir-192 and Co-60 are well established as the commercially available HDR sources, while Co-57 is not commercially available and requires an alpha or proton beam for production. Co-60 and Ir-192 have very similar physical dimensions and our planning studies have demonstrated small differences between the two radionuclides: 2.4% increase in HR-CTV ($p<0.01$) and 3.3% increase in D2cc rectum ($p<0.01$) when using Co-60 compared to Ir-192, when prescribed to ICRU Point A and with consistent loading patterns, these small differences may indeed be swamped by other larger uncertainties in brachytherapy. Figure 1 demonstrates the treatment duration with Co-60 is no longer than for an Ir-192 source for a typical treatment up to 4 years (typical source lifetime). The greatest difference is seen in the nominal costs for the commercially available sources and the additional physics support required for source changes. Co-60 is €325,000, €100,000 cheaper than Ir-192 over the 10 year lifetime of the HDR equipment. 40% additional physics support is required for Ir-192 source changes.